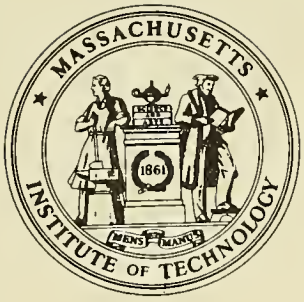

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ON THE TECHNOLOGICAL FOUNDATIONS OF ECONOMIC DUALISM*

Michael J. Piore

Number 110 May 1973

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Michael J. Piore

Number 110 May 1973

*I am grateful to my colleagues in the Ford Foundation dualism project; Suzanne Berger, Lisa Peattie, and Martin Rein, who helped me in the development of these ideas (even though I cannot seem to convince them of their validity) and also to both Paul Joskow and Sherwin Rosen for, among other things, taking me seriously in all this.

The views expressed in this paper are the author's sole responsibility and do not reflect those of the Department of Economics, the Massachusetts Institute of Technology, or the Ford Foundation.

This paper endeavors to develop a theory of the technological foundations of economic duality. It is directed specifically at defining the relationship between three distinct views of market duality; dual labor market theory, which postulates the division of the labor market into a primary and a secondary sector; dual product market theory, which postulates the division between large, capital intensive enterprises at the center of the economy and a fringe, or periphery, of small, marginal firms; and the dual economies of the development literature which distinguishes between a modern and a traditional sector.

The original impetus to develop the underlying concepts presented here was the desire to understand the technological foundations of labor market structure. And, in the process of clarifying the relationship among the various concepts of market duality, the paper is supposed to serve that second function as well. The particular labor market structure toward which the theory is aimed is an expanded version of the dual labor market hypothesis.

The original version of the dual labor market hypothesis postulates a division between a primary and a secondary sector distinguished from each other by the greater stability of jobs and workers in the primary sector and the tendency for that sector to offer jobs which, relative to the secondary sector, have higher pay, better working conditions, greater chance of advancement, and an institutional, as opposed to personal, relationship between supervisor and subordinate. The expanded version of this hypothesis recognizes a division of the primary sector into a lower and an upper tier. The latter is composed of professional and managerial jobs. These jobs do not share all of the characteristics ascribed to the primary sector in the original version. In particular, they seem to involve less stability and a less institutionalized relationship between supervisor and subordinate. The distinguishing feature of the upper

tier, however, lies not in particular job traits, but in the nature of cognitive traits, and the process through which they are developed, a point to which we will return in detail below. Between the upper and lower tier lie a series of craft jobs which often utilize cognitive traits comparable to those in upper tier jobs but which develop those traits in the manner of the lower tier.[1]

For the dual product market theory, the reader is referred to the Dual Economy by Averitt[2] and to the literature emanating from Robin Marris's Managerial Capitalism[3] and Galbraith's New Industrial State.[4] Marris and Galbraith argue that modern business enterprise is characterized by very large firms who, in particular contrast to the postulates of economic theory, control the markets in which they operate. They exercise this control not only over the price and quality of their product, but also over the stability and uncertainty of its demand, and, through large reserves of internal funds, over the capital required for its production. Such control is a result, but also a necessity, of the size of the enterprise, and the capital intensity of modern production. It produces a substantial interest on the part of the firms in growth and market share independent of the contribution which these make to profit (at least in the short run).

Averitt argues that such firms are only one sector of a dual economy, whose other sector is composed of smaller, competitive enterprises. In Averitt's second sector fall most of the examples which the orthodox critiques of Marris and Galbraith cite in defense of conventional theory. In this

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[1] See Michael J. Piore, Notes for a Theory of Labor Market Stratification, M.I.T., Department of Economics Working Paper No. 95, October, 1972.

[2] Robert Averitt, The Dual Economy (Norton & Co.; New York, 1968).

[3] Robin Marris, The Economics of Managerial Capitalism (Great Britain; The Glencoe Free Press, 1964).

[4] John Kenneth Galbraith, The New Industrial State (Boston; Houghton Mifflin Co., 1967).

sense, Averitt, without referring to that debate, in work whose origins apparently predates it, seems at least to me, to define the problem which the debate itself illustrates and in so doing, paradoxically, obscures.

The distinction in the economic development literature with which we are concerned arose initially in discussions of peasant agriculture. More recent work has emphasized the traditional urban sector, consisting of small service and manufacturing firms, operating on a scale, with a technology and labor force which contrasts sharply to that of modern capital intensive, often foreign owned and export orientated firms. The literature has usually assumed that these industries are the vestiges of a preindustrial economy which shrinks as development proceeds and ultimately disappears. Recent work by my colleague Suzanne Berger on the advanced economics of France and Italy[5], as well as the discovery of dualism in the labor product markets of the United States, suggests that this assumption is perhaps misplaced.

The theory of technology upon which the paper rests is an expanded version of Adam Smith's basic postulate that the division of labor is related to the extent of the market. That is developed in the first section of the paper. The theory is then applied to derive the dual product market of developed economies in the second section and the dual market of underdeveloped economies in the third section. The conceptual relationship between the division of labor and the various labor market strata are developed in the fourth section. Section V then goes on to apply those concepts to the theory of labor market structure and the relationship of various types of economic dualism.

To avoid subsequent confusion, it should be stated at the outset that this is not an attempt to assert that the structure of labor markets (or for that

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[5] Suzanne Berger, The Uses of the Traditional Sector: Why the Declining Classes Survive, November, 1972; mimeo.

matter, of the economy as a whole) is technologically determined. On the contrary, the concepts developed here are designed to fit into a larger theory in which the characteristics of the labor force and a set of institutional factors, reflecting political and social forces emanating from the larger society in which the economy is embedded, receive explicit consideration.[6] On the other hand, the theory is predicated upon the notion that the roles of institutional forces and of labor forces characteristic in determining market structure are played out within a set of technological forces which constrain and channel their impact and that there is probably an elementary technological core to the economy which is impervious to assault by alien institutions and workers and will mold the latter to its own image before it gives way.

I. Technology

The conventional approach to technology in modern economic theory has been to define it in terms of combinations of various factors of production, the choice among which is governed by relative factor prices. This has been true of the choice within a given set of known techniques of production, a problem for which there is a fully developed and generally accepted solution. It has also been true of the search for new techniques of production. There is no generally accepted solution to the latter problem but virtually all recent efforts to solve it have taken this approach.[7]

In this essay, we return to the earlier, classical view, originating with Adam Smith, in which the forces commanding the evolution of technology lie

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[6] See Michael J. Piore, Working Paper #95, op. cit. In a sense, this essay is a substitute for Section III-1 (p. 26-31) of that paper.

[7] See, for example, Paul A. Samuelson, "A Theory of Induced Innovation Along Kennedy-Weisacker Lines", Review of Economics and Statistics, Vol. XLVII (November, 1965) pp. 343-356.

outside the factor markets and are inherent in the nature of technology itself.[8,9]

Smith's basic postulates are twofold: a) that productivity (output per unit of input) is a function of the division of labor and b) that the division

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[8] Since this is not essentially an empirical paper I have removed from the text most of my efforts to give the postulates empirical plausibility. My own views on this matters are heavily influenced by my doctoral dissertation project to which the reader is referred (Michael J. Piore Technological Change and Structural Adjustment in the Labor Market unpublished doctoral dissertation. Harvard University, 1966) That project was an attempt to understand, through interviews with design engineers, the influence of the labor market upon the selection of technology . The dissertation is a tortured attempt to squeeze into a neoclassical format the findings of the study, which make complete sense in Smithian terms. What is clear from the study is that modern managers do not think of substituting one kind of labor for another: they think in terms of the division of jobs into a set of component tasks. The proportions in which types of labor are employed is a biproduct of this decision. Decisions relative to capital are cast in terms more nearly approximate to that of neoclassical theory but one cannot so fundamentally change the terms in which labor choices are made without affecting the choice between capital and labor as well.

[9] Adam Smith's formulation has enjoyed a kind of fugative existence in the consciousness of post-Marshallian economics. Prior to World War II, it was the subject of an active literature, which largely died out in the postwar period. Two pieces of that literature were brought to my attention while working on this paper:

Allyn A. Young, "Increasing Returns and Economic Progress," The Economic Journal, December, 1928, No. 152, Vol.XXXVIII, p. 527-542, and
G.L. Stigler, "The Division of Labor is Limited by the Extent of the Market," Journal of Political Economy, LIX (1951) pp. 185-193.

I am indebted to Sherwin Rosen for the former reference and to Paul Joskow for the latter. Neither of these two articles makes precisely the points upon which the argument in the text rests but they are clearly part of the same train of thought, and it is entirely possible that some of the points made above -- perhaps all of them -- appear elsewhere in some article I have not reviewed.

On one important point, however, the argument of the text is in opposition to that of these two articles. Stigler, and to a lesser extent Young, are preoccupied by the apparent implication of Adam Smith's original postulate that there are increasing returns to scale and, hence, that a competitive market cannot be technically sustained. The argument in the text embraces this implication and, indeed, draws heavily upon it.

of labor is a function of the extent of the market.[10] Smith developed his first postulate in terms of the standard and now classic example of the pin factory, where the production operation is broken down into a number of small tasks ("One man draws out the wire, another straightens it, a third cuts it, a fourth points it, a fifth grinds it, ...") permitting the group of workers to produce a volume of pins far in excess of that which could be produced if each man made whole pins by himself. Smith adduces three reasons why this should be the case: (1) improved dexterity on the part of the workmen, (2) the saving of time which would otherwise be lost in moving from one task to another, and (3) "the application of machinery invented by workmen" who, in concentrating their attention on a single task, see opportunities for improvement which would otherwise be overlooked. To these three factors, I would add a fourth and fifth factor: (4) the separation of work into a series of component parts, which is involved in the division of labor, appears to be critical to the intellectual process of technological change. Each of the component parts becomes a problem which can be solved separately whereas, in the aggregate, it is difficult to define the problem, let alone solve it. Indeed, one is struck by how many mechanical inventions simply duplicate the movements of human beings. The process of the division of labor, particularly as it is practiced by modern industrial engineers, is one of separating out and simplifying the human movements involved in performing given tasks. (5) Finally, the efficiency of machines, like men, appears to increase when they are specialized. The example in our own time is the TFX, a plane designed to serve the needs of both the Air Force and the Navy. The plane was suboptional for both branches of the service (but argueably cheaper).

Of the five factors explaining the effects of the division of labor, two

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[10] All of this is to be found in Book I, Chapter 1 of the Wealth of Nations.

are related to the application of machinery. It follows from this that increased division of labor will tend to be associated with increased use of physical capital. It does not necessarily follow that it will be associated with some monetary measure of capital, but there is, I believe, a strong presumption that such is the case.

Adam Smith's second postulate, that the division of labor is limited by the extent of the market, rests essentially upon the following idea: If "work" is thought of as divided into a set of tasks, an industry which produces one item a day might have one worker doing all of the tasks; if output expanded to two items, it could have two workers, each doing half the tasks; at three items, it would be three workers doing one-third of the tasks, and so on until each worker did a single task. (Since the whole rationale for this is increased productivity, the work day would get shorter, or output larger, with each division). Obviously, the limit to this division of labor is the number of items produced, and this, in turn, depends on the extent of the market. Smith seemed to think of the extent of the market in a geographic sense but, as the above example suggests, what is really involved in the concept of the "extent of the market" is the absolute number of items relative to the number of work tasks. The "extent of the market" in this expanded sense of the term will increase with the level of income, and rising income levels will give rise to increasing productivity. More importantly, in terms of the argument developed below, the extent of the market for an individual firm will depend upon the firm's size.

In addition to the extent of the market, we would add to Adam Smith's determinants of the division of labor, three other factors: (1) the standardization of output: (2) the stability of the demand for output, and (3) the uncertainty of demand for output.

The degree of standardization is partly a definitional matter. As we have defined the extent of the markets, any given output or "bundle of goods"

might range from one in which all items in the bundle were the same, to one in which each item was different. Smith would say that in the former case the market was more extensive than in the latter. But you could equally well say that the former case output was completely standard. The "degree of standardization" carries connotations, however, that are not carried by "extensiveness." Thus, for example, the output of cars can be more or less standard depending upon the number of parts which different models have in common. Because of the importance of standardization, there is considerable interdependency among industries in the technology which each will find profitable to implement.

In terms of the argument of the current paper, the more important additions to Smith's list are stability and certainty, particularly the former.

Stability will affect the division of labor in two ways. First, where demand is unstable, and fluctuates up and down, workers will be deployed from production during the downswing. A quick review of the list of factors favoring division of labor will indicate that the gains will be reduced when output, and by extension, employment, is intermittent. Thus, each level of instability in a given total output is equivalent, in terms of the profitable division of labor, to some smaller, stable level of output. Second, to the extent that the division of labor involves increased capital investment and that capital is so specialized that it cannot transfer to other uses during troughs in demand, the periodic unemployment of capital which instability entails will also deter the division of labor. A similar argument can be made about the specialized labor skills which the division of labor seems to entail, provided there is some institutional mechanism which forces the unemployment of these skills to be accounted in technological decisions.

The relationship between uncertainty and the division of labor follows from a similar set of considerations. Production schedules can be stabilized and economies of divisibility realized even in the face of considerable instability in product demand through variations in inventories, but inventory investment will be discouraged when the fluctuations are unpredictable. Uncertainty will also discourage the investment in fixed capital which seems to accompany the division of labor.

In Smith's model, the division of labor is viewed largely as a state of technology at any given moment of time. And one can conceive of a series of such different states. The resulting curve would play something of the role which the production function does in neoclassical models. A diagram of such a curve is presented in Figure I.[11] For any given extent of the market (and in our expanded version of Smith's model, standardization, stability and certainty) there is some optimal division of labor to which the economy will move.

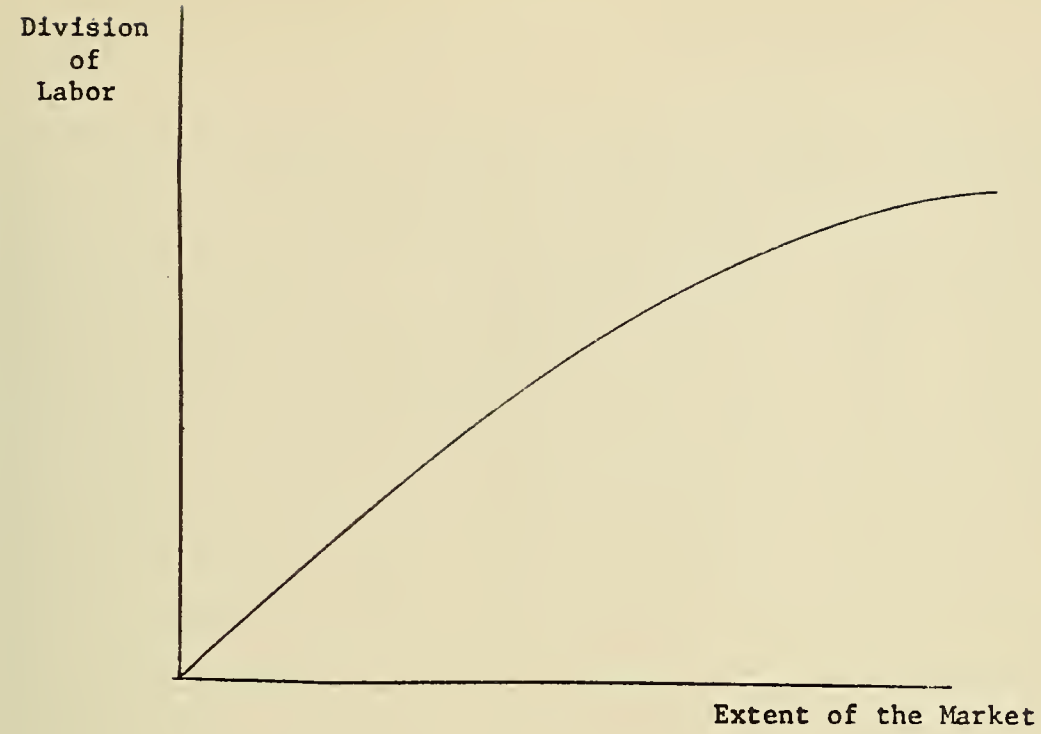
Bunching and Irreversibility

To this basic theory about the relationship between the extent of the market and the division of labor, I would add two further postulates: one about the irreversibility of technology and the second about a tendency toward bunching.

The irreversibility of technology in the long run seems implicit in the fact that several of the factors which make productivity dependent upon the division of labor (particularly numbers 3 and 4) are related to innovations. Such innovations, once they occur and are put into operation, are not likely to be forgotten. So long as the innovations have some generality (i.e. they

[11] The relationship which actually drives the economy is that pictured in the first quadrant of Figure IA between the extent of the market and labor productivity. This relationsip is derived from the relationships between the division of labor and the extent of the market in the fourth quadrant and the division of labor and productivity in the second quadrant.

Figure I



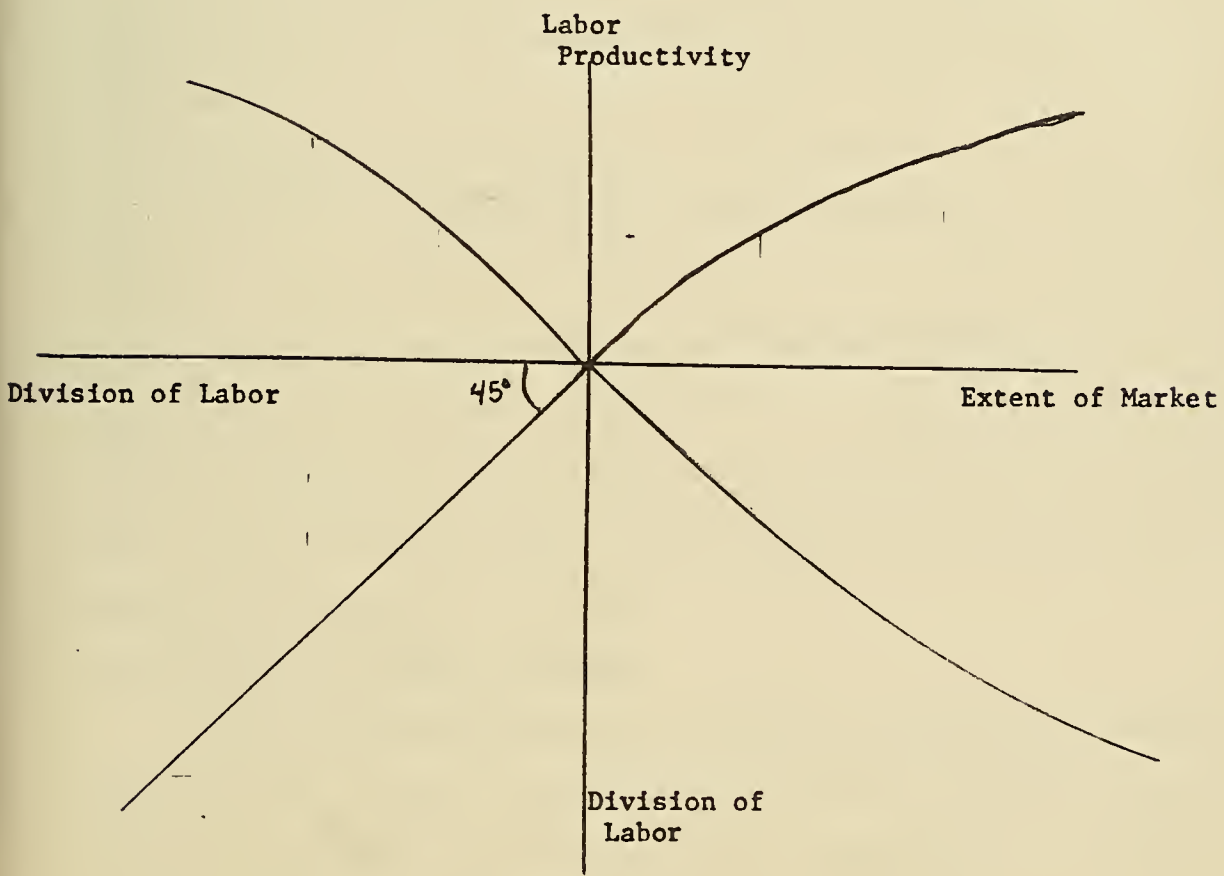


Figure IA

are not just applicable at one point along the curve), they imply that an industry will not regress when its market contracts along the same productivity path which it expanded. If, as seems likely, such innovations embody the division of labor characteristic of the time at which they are made, they will prevent the industry from contracting along the same division of labor path as well. In the short run, irreversibility will also be created by fixed investments in capital equipment embodying a given division of labor, and the fact that so much of a technology is oral knowledge that is forgotten when not actually in use. In the long run, of course, capital equipment wears out and forgotten knowledge is rediscovered. Those things can, however, take some time.

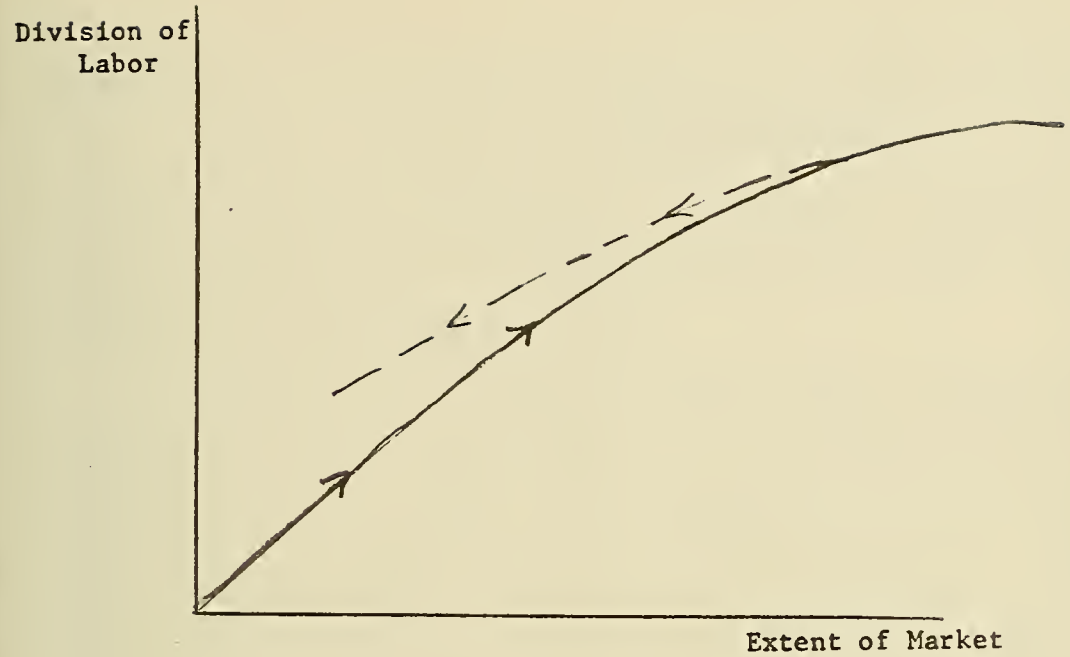
The irreversibility postulate is represented grammatically by the broken line in Figure II. The arrows in that figure show the direction of movement over time.

The bunching of technology follows from the notion that the division of labor is related, in addition to the extent of the market, to the standardization of output. Since the output of some firms constitutes inputs into the productive processes of other firms and the nature of the inputs required depends upon the technology, this relationship implies certain economies from shared technologies. And these economies, in turn, constitute an incentive for firms and industries which would otherwise be spread out in any kind of technological space to bunch together around one or a few points.

Applications to Economic Processes

The basic relationship which we have been developing may be used to characterize, at least, three distinct phenomena. Smith himself used it to explain the increase of output for a given resource input, a process which might be termed quantitative economic growth for the economy as a whole. Secondly, the relationship may be used to trace the development of a single

Figure II



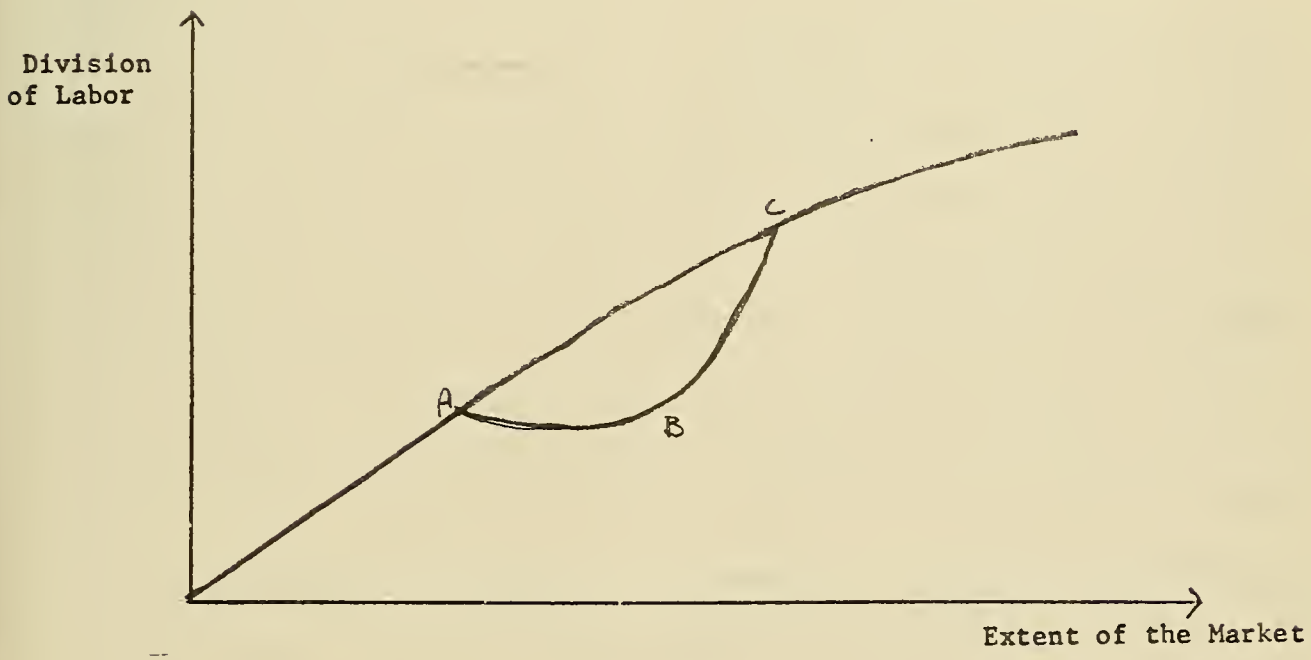


Figure III

industry as it is born, grows to maturity and then decays, and in this way can be extended to understand the qualitative dimensions of economic growth in which the industrial composition of output shifts continually over time. Finally, the same basic relationship may be used to study the state of an industry at any given moment of time.

In characterizing quantitative economic growth, the relationship between the division of labor and the extent of the market may be interpreted as the growth path for the economy. The economy moves along this curve over time, and, at any given moment, is located at one point along it. One may wish to make a further distinction between long-run and short-run development. In the short run, the extension of the market may out-run the ability of the economy to fully exploit the benefits of it, particularly where these benefits are dependent upon innovation and capital investment. The actual course of movement between any two points may thus be better approximated by the path ACB as in Figure III.

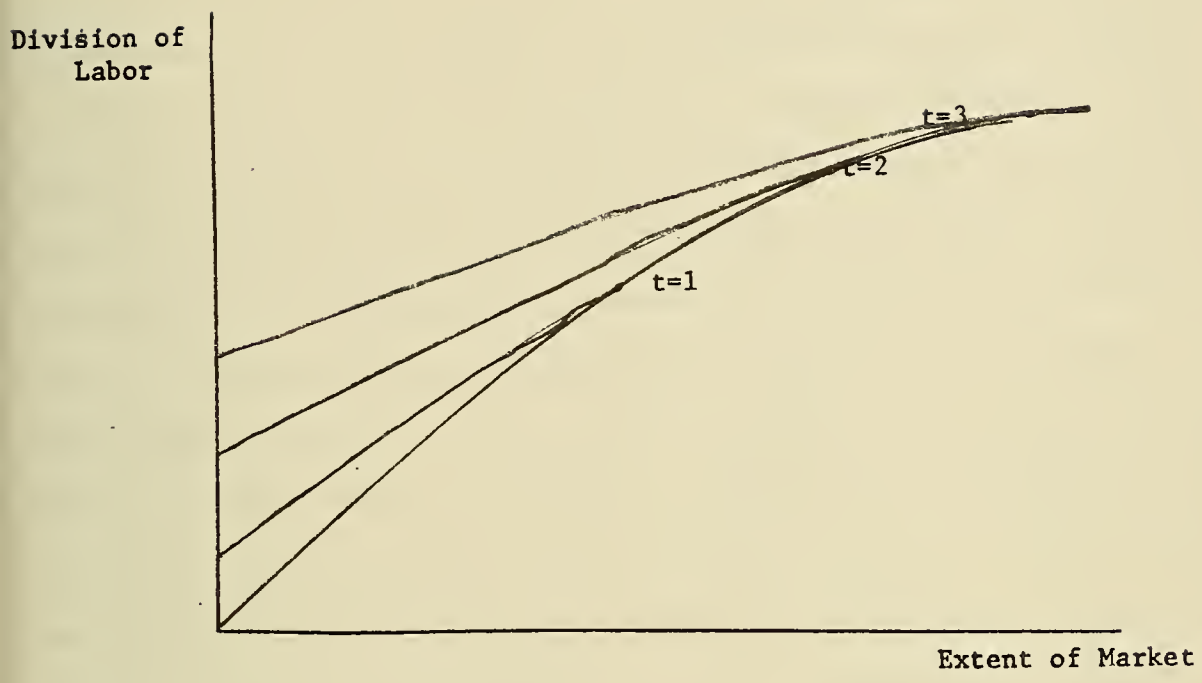
Just as the economy may be said to transverse such a curve over time, so any single industry may be said to do so as well. For individual industries, however, the growth is not unidirectional. At some point in time, industrial demand reaches a peak, and then begins to decline as substitutes are invented and economic growth shifts to other locations. Because much of the movement is irreversible, the decline of an industry would not take place on the same path along which it expanded, however, but rather along a higher, flatter path like that shown in Figure II. The fact that it does so insures that economic growth is not solely an index number phenomenon. Without such irreversibility, in other words, it would be quite possible that the productivity gains in expanding industries were simply compensating for the productivity losses in declining industries, but that the former systematically appear to outweigh the latter

because the relative prices in industries when they were expanding must almost by definition be higher than when they are contracting.

The third relationship which the curve may be said to illustrate is the state of a single industry at any moment of time. Products which are very similar in terms of their inputs and the character of their output and, except for differences in the division of labor, in the basic process through which they are produced, may exhibit substantial variations not only in the quantitative extent of the market but also in the degree of standardization and, even more importantly, in the stability and certainty of demand. Examples which come to mind include the garment industry, whose products range from work clothes at one extreme in virtually all of these respects to haute couture at the other. Restaurants run a similar gamet from short order lunch counters to haute cuisine. In most industries, the variation is probably continuous enough so that one might think of the whole industry as being spread out along a path very similar to that transversed by its most extended component in its initial growth. The path along which the industry is spread will probably not, however, be the same as that along which the part located at the end point developed. Some of the innovations in the most extended part of the industry are likely to be applicable to the less extended parts and thus operate to increase both productivity and the division of labor all along the line. Hence, as the end point of the industry moves outward the curve along which the rest of the industry is located should shift upward as shown in Figure IV.

This view of the growth path as capable of representing a single industry at any moment of time should be modified in one important respect. The principle of bunching makes it highly unlikely that the actual distribution of

Figure IV



the industry will be continuous. The bunching principle does not indicate how many points along the curve will actually be developed. That will depend upon the nature of the economies of scale involved and could in principle range from one to some quite large number. It need not, moreover, be the same for all aspects of the technology, some of which might be more standardized (or bunched) than others. The dependence of the division of labor upon the stability of demand suggests, however, that there will be two important modes. This is so because any demand can be divided into two segments, a stable and an unstable portion. Such a division is suggested by the dotted line in Figure XIV which graphs a hypothetical product demand over time. The stable portion lies below the line, the unstable portion above it. The conclusion is not basically changed by permitting inventory accumulation: in most industries, that will merely reduce the unstable portion of production; it will not eliminate it. This distinction between the stable and unstable technology creates an important dichotomy upon which considerable weight is placed in the argument below.

II. Dual Product Markets:

The preceding theory of technological change may be applied directly to yield an explanation of a dual product market. The parts of the argument necessary to do so may be briefly summarized. They are Adam Smith's two basic postulates:

1. That productivity is dependent upon the division of labor, and

2. That the division of labor is a function of the size of the market. And two of the additional propositions added in the preceding section:

3. That the division of labor is also a function of the stability of demand (uncertainty works in the same way as instability but is not critical to the argument), and

4. That any product demand can be separated into a stable and an unstable portion, the two portions being separated by the floor to which demand falls at the trough of its cycle.

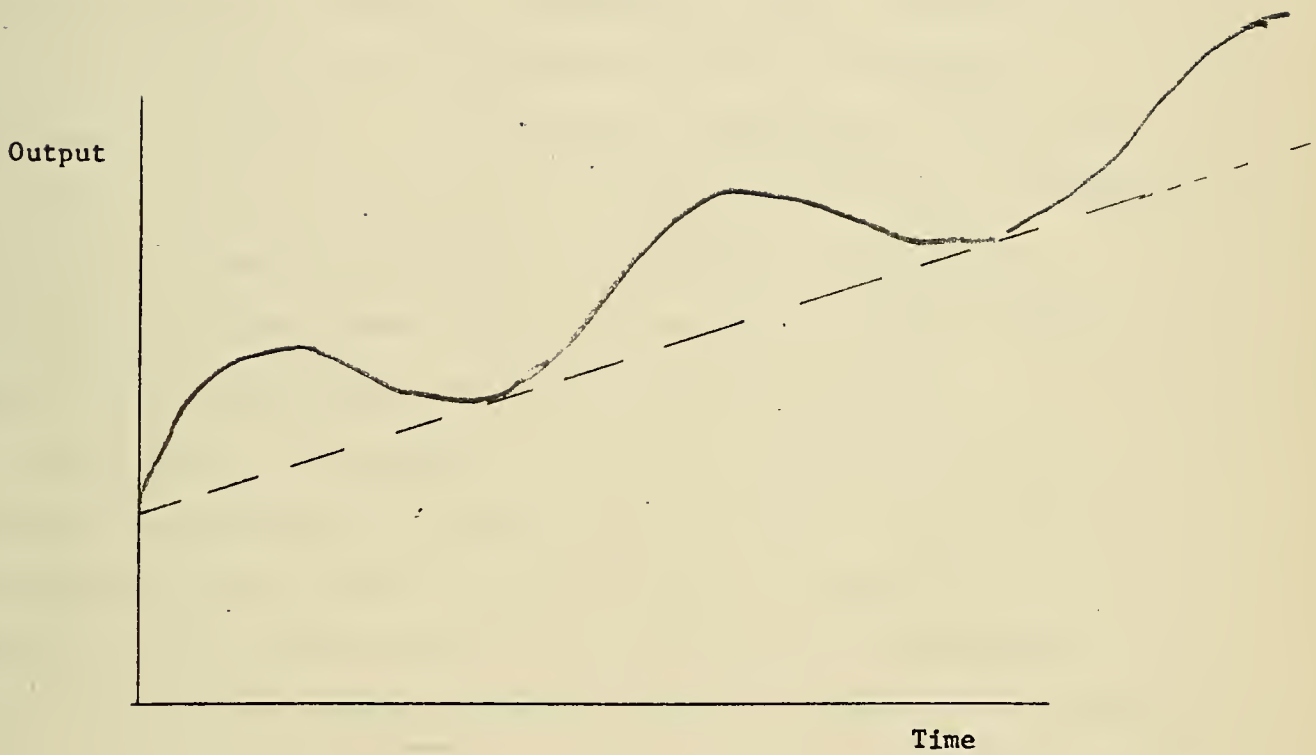


Figure XIV

The critical element in explaining a dual product market is the implication of Adam Smith's original postulates for the size of the firm. So long as productivity is solely dependent upon the division of labor and the labor depends only on the size of the market, each firm will face a declining average cost curve, ie., the larger its output, the smaller the unit cost of production. This means that any firm can cut costs by absorbing its competitors. It can, moreover, continue to cut costs until it is the only firm in the industry. Thus, Adam Smith's theory of technology is one which is basically antagonistic to competition, and this is undoubtedly one of the reasons it has fared so poorly in modern economic theory, which draws so heavily upon the competitive assumption.

The addition of stability to the theory as a determinant of the division of labor reduces the optimal size of the firm to something less than the size of the industry and, thus, restores the possibility of competition. But it does so only so long as the last proposition fails to hold. If demand can be compartmentalized into stable and unstable segments, the declining average cost curve will prevail for the stable segment and, in that segment, the theory implies that a single firm will emerge. Firms in the unstable segment will retain the traditional u-shaped average cost curve, and in that segment, one could expect to find a number of much smaller firms.

Uncertainty has much the same effect as demand instability. Because as noted earlier, stable production can be maintained in the face of product demand, by variations in inventories, it may be profitable for the large, or stable, sector of an industry to expand above the demand floor and into the fluctuating component. Such an expansion, however, will be detered by uncertainty, which increases the risk that the firm will get stuck with

excessive inventories.

This, then, constitutes the technological basis for duality in the product market: large scale enterprise with declining average cost curves catering to the predictable and largely stable segment of demand and much smaller scale firms with the traditional u-shaped average cost curves catering to the unpredictable and/or fluctuating portion of demand.

Most of the characteristics of firms which Marris and Galbraith emphasize is their description of managerial capitalism and the new industrial state can be traced to the peculiarities of a location in the stable segment of such a dual market. Such firms would be capital-intensive because capital-intensity tends to accompany the division of labor. They would be preoccupied by growth, to the point where it seems to eclipse other managerial goals, because they face declining average cost curves and hence, growth up to the limit of stable demand (and, if fluctuations are predictable, even beyond that limit) is always profitable. They would tend to be preoccupied by market share because market share is a good proxy for the stable portion of demand. The paradox, which their critics have emphasized, that both the firms and the authors who describe them should believe that they have controlled product demand when demand remains so obviously unstable and unpredictable, is explained by the fact that these firms have not attempted to control the whole of product demand but rather to separate out that portion which lends itself to control.

The theory does not yield a very satisfactory explanation for the number of firms in the stable sector: if average cost curves do indeed decline continuously there should be only one such firm in each industry. The presence of several large firms suggests that perhaps the division of labor reaches a saturation point (at which point the average cost curve would level off and turn up). But it seems equally plausible that, when the number of

firms in the stable portion becomes very small, further concentration is thwarted by anti-trust legislation, cartel agreements, or tacit understandings generated by a mutual fear of the kind of competition which would be required to further reduce the number of enterprises.

All of this, it is to be noted, depends upon the proposition that demand can be segregated into a stable and an unstable portion. The technological theory which derives from Adam Smith only suggests that there are large economies to be had from doing so. But these economies are social and in a market economy such as ours, they must somehow be privatized if they are to be realized. And it is not easy to conceive of a single set of institutional arrangements which would permit this to happen. The way in which it happens in practice seems to vary substantially throughout the economy. Thus, in the automobile industry, the solution appears to be that the whole of product demand is controlled by the big three, who then segment production, building up an in-house capacity for the stable component and subcontracting the unstable component to a variety of smaller "parts" producers. In the machine tool industry, where the stable firms are smaller and more numerous than in autos, the market seems to be segmented by a waiting period. As demand expands above the floor, the customers of the stable firms are forced to wait in line, and a variety of small job shops using highly skilled labor and substantially less specialized capital euqipment grow up to meet the demands of those who become impatient with the waiting period. In the garment industry, the division seems to follow product lines more closely, the stable portion of demand being composed of, for example, work clothes and the unstable portion, women's dress clothes.

Two final notes about dualism in the modern economy: first, the peripheral sector need not be composed solely of firms catering to the unstable or un-

certain portion of demand in a larger industry. There may also be a number of firms which, due to the special nature of the product or geographic differentiation or the like, simply have very small, albeit quite certain and stable markets. A number of household services fall into this category, as do, as well, certain professional services. The theory also suggests that new industries and declining industries will tend to resemble the peripheral sector.

Second, the theory does not necessarily imply that all peripheral firms will be similar -- differences in the instability and uncertainty of the peripheral sector among industries may produce substantial variation in their technologies. The peripheral sector of some industries might even resemble the core sector of other industries in terms of this position on the "division of labor" curve, although the usefulness of the theory would be considerably weakened if this were a frequent occurrence.

The principle of bunching, however, should work to make the peripheral sector in industries very similar. At least within rather large sectors of the economy. Thus, for example, the whole economy shares the same basic door, window, bathroom and kitchen fixtures, a fact hardly noticed until one visits a foreign country. Most manufacturing firms, particularly in the peripheral sector, share the same basic tools and transport equipment; the service sector uses the same office equipment, and so on. Thus, in terms of the basic diagram, the forces peculiar to each industry may tend to dictate two distinct points along the basic technological curve and ceteris paribus the points might differ for each industry so that, although industries were dualistic, the economy as a whole was spread out along a continuum. The economies of bunching, however, will tend to force individual industries to make certain compromises in order to share the common technology, and this should tend to project the dualism within each industry upon the economic structure as a whole.

III. The Dual Economy in Economic Development

The dual product market in underdeveloped countries can be derived by using Smith's basic relationship between the division of labor and the extent of the market to represent the developmental path of an economy over time. The fact that the economy is basically underdeveloped implies that its domestic markets are small and that its own industries -- those catering to the local market - - will be found on the far left side of the curve. The modern sector, almost by definition, is located at some point on the far right of the curve. It is composed of enclave economies catering to a much larger metropolitan, or world market, and, by virtue of the much larger size of that market, consists of large,capital intensive enterprise.

This kind of underdeveloped dualism, it should be noted, resembles the dualism in developed economies because both derive from the same underlying relationship, that among the extent of the market, the division of labor, and productivity, but the causes of dualism are different. In the underdeveloped case, it is the existence of different industries with markets of very different sizes; in the case of developed economics, it is the existence within the same industry of markets with very different degrees of stability.

As the underdeveloped economy develops, it should begin to generate the kind of dualism associated with the modern economy and the importance of the traditional sources of dualism should decline. But one can imagine, however, a number of ways in which the two sources of dualism might interact with each other. The small institutions of the traditional sector might, for example, simply shift their function to that of handling the unstable portion of demand in a modern economy; or they might disappear completely and be replaced by a new set of modern (but peripheral) firms. In France and Italy, it appears that special efforts have been made to preserve the traditional sector through state subsidies (a similar phenomenon has occurred in Puerto Rico), and the modern sector may have utilized the political power of the traditional sector to support its own

dualistic structure.

IV. A Theory of the Job Structure

To move from the theory of technology and product market structure of the preceding sections to the structure of labor markets requires a theory about the way in which technology affects jobs. It is to the development of that theory that we now turn.

A. Basic Definitions and Hypotheses:

The theory rests upon a set of definitions and hypotheses. The first of these is that of a job which is defined as consisting of an identifiable set of tasks that the worker who holds it must be able to perform. A job is not a concept that is generally recognized in economics, and this particular definition is borrowed from industrial engineering. Its major weakness is in describing jobs where an important requirement is the ability to relate to other people involved in the productive process, and that weakness is probably reflected in the concepts under development here.

The term skill, when used in relation to a job, refers to the number of tasks of which the job is composed. Jobs are more or less skilled depending upon whether they involve a greater or lesser number of tasks.

A worker is characterized by a set of productive traits. These traits determine the tasks which a worker can perform and, hence, the jobs which he is qualified to fill.

Worker traits are of two qualitatively different kinds.[12] We shall designate these by the terms task-specific and task-general. The modifier "task" is used to distinguish the terms general and specific here from other uses of the term in the literature of labor economics such as, for example, by Gary Becker in his book on human capital and by Peter Doeringer and I in Internal Labor Markets.

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[12] The following discussion of worker traits and learning is based upon that in Michael J. Piore, Notes for a Theory of Labor Market Stratification, M.I.T. Department of Economics, Working Paper #95, October 1972. Some of the points are developed in more detail there.

A task-specific trait is generally the ability to do a particular (specific) task. It tends to consist of a habit of behavior or thought which is known by rote and displayed automatically, without deliberate thought or conscious effort, in response to a set of clues offered by the environment. Traits of this kind tend to be acquired through a process which I have termed "automatic, incidental learning" and which depend heavily upon habit formation, imitation, and socialization. All of these learning processes involve direct exposure to a situation in which the traits involved are utilized, and hence, displayed and the range of tasks which an individual can perform is thus limited by his experience.

Task-general traits, on the other hand, consist of a set of general rules from which the individual "deduces" the modes of behavior and thought required to perform a particular task. Performance based upon such traits involves, in other words, a process of reasoning, and requires the conscious attention of the worker to his work. In contrast to task-specific traits, general traits enable the worker to perform tasks which he has never previously encountered.

In our society, the acquisition of task-general traits appears to depend heavily upon a formal education process in which the individual is taught the general rules in which such traits consist. Effective utilization of general traits acquired in this way, however, seems to involve practice in their application, and if that practice is too narrowly focused upon a few specific applications, those applications are learned as specific traits and the general rules from which they derive atrophy and are lost. It appears to be possible to develop general traits in a second way, involving little or no formal education, by teaching an individual a series of successive specific traits, all of which derive from a single, general rule, until eventually the applications

cumulate to the point where the individual induces the general rule at stake. This might be called learning by epiphany, because it is a learning process in which the general rate suddenly emerges out of a series of what were previously disparate parts.

Both methods for the development of task-general traits depend upon variety for their success. Without this variety, a set of rules learned formally in the classroom will atrophy and a set of specific traits learned on the job will remain too narrow to allow for generalization. The need for variety here stands in some contrast to the process through which specific traits are developed, all of which require a certain stability in the environment. Such stability is required in classical habit formation because that depends upon a repeated association between behavior and re-enforcement. Learning through imitation similarly depends upon repeated exposure to a given behavioral pattern, and the process of socialization presupposes the existence of a stable social group with established behavioral norms. Stability and variety, it may be noted, are not necessarily mutually exclusive (this is why learning by epiphany, which is in essence a process in which general traits are acquired through specific traits, is possible at all). But the one does often tend to exclude the other (which is why learning by epiphany is relatively rare).

B. The Choice Among Alternative Learning Processes

There are certain kinds of tasks which are performed in the economy which are unique. The precise task (or tasks) involved either have never previously been performed or, if they have been previously performed, it is impossible to know in advance that they will be required again. The terms invention and innovation as these are used in the literature of economics generally have reference to tasks of this kind. In any organization, there appear to be jobs which seem to have a large element of this type of task. Thus, the chief task

of a plant manager (and in certain but not all manufacturing situations, the foreman in a manufacturing plant) is to handle the unusual, the unique, and the nonroutine. Only task-general traits will permit satisfactory performance in jobs of this kind. But for most jobs, task-general and task-specific traits are substitute ways in which the tasks can be done. The organizers of production implicitly face a choice (implicitly because the choice does not present itself in precisely these terms) as to which of these approaches they will rely upon. And the society is faced with a similar choice as to which of these alternative kinds of traits to develop in its labor force. Choices of this kind are presumably based upon relative costs.

The theory as we have developed it thus far does not speak directly to the question of cost. It does, however, imply certain relationships between the learning time required and the number of tasks which the individual requires the ability to perform. The implied relationships are shown in Figure V. As the diagram suggests, the basic characteristic of the development of trait-specific traits is that the ability to perform each task is learned separately and hence the learning time is basically a function of the number of tasks mastered. The learning time for general traits is, by contrast, independent of the number of traits required. (We ignore here the problem that a single set of general rules will not cover all tasks--but this can be resolved without changing the results).

Were the society to value learning time at a constant rate, cost could be substituted for time on the y-axis and the two learning curves would constitute cost curves as well. Such a diagram implies that, in an economy where economic decisions are made to minimize cost, the form of learning (and hence the type of traits)utilized will depend upon the number of tasks which a job requires. Unskilled jobs, involving very few tasks, would tend to utilize

Figure V

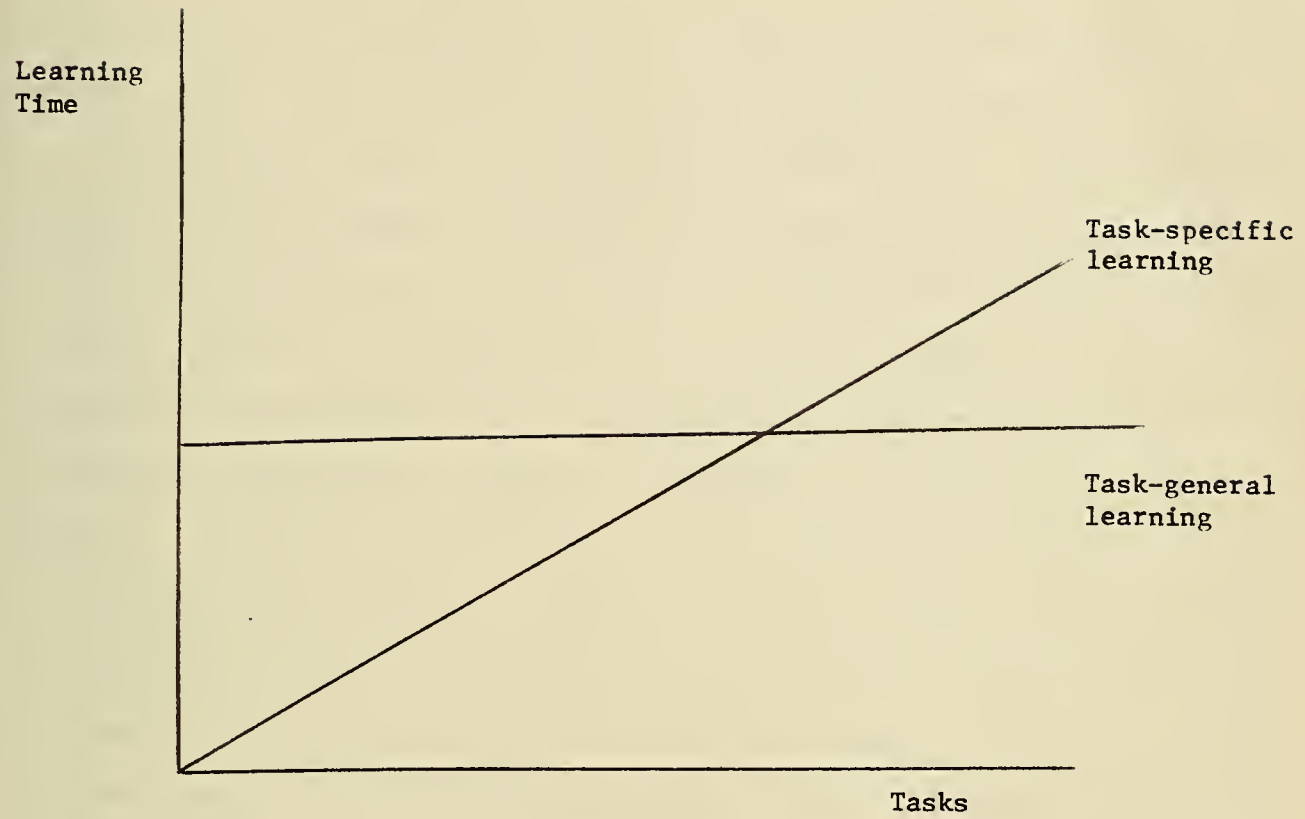


Figure VI

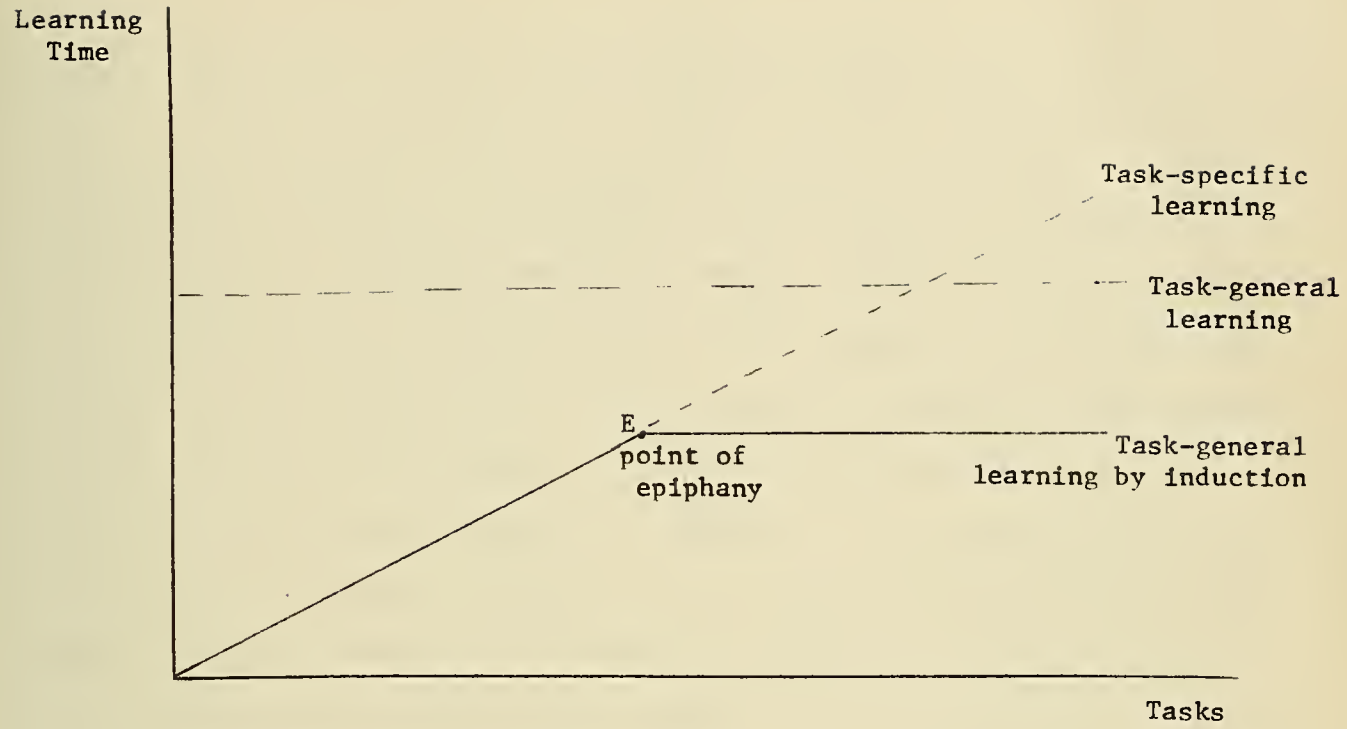
task-specific traits: highly skilled jobs in which the worker was required to perform a great number of tasks would tend to utilize task-general traits.

Much of what follows utilizes this very simple result. But it must be recognized that, although a recognition of the complexities does not seem to invalidate the usefulness of this result for the immediate purpose at hand, learning time does not translate into cost in any very simple way. One major amendment to the proposition that it does is the recognition that much of the learning for task-specific traits is an automatic-incidental biproduct of production. In this sense, the process of task accumulation, so long as it follows the contours of the productive process, is virtually costless. The number of tasks which the worker learns beyond that point, however, involves major and presumably costly, modifications in the production process. This implies that the cost curve for specific-learning probably more closely resembles that drawn in Figure VI than in Figure V.

A second particular case of some general interest is that of learning for craft jobs. The basic characteristic of craft jobs is the large number of tasks which a craftsman must perform. Craft jobs seem, however, to be filled both by workers operating on the basis of task-specific traits and by others working from task-general traits. The basic explanation for this mixture seems to be "epiphanal" learning: the basic learning process is that associated with task-specific traits but so many tasks are mastered that certain craftsmen are able to induce the general rules which underly the processes involved. It is as if they followed a hybrid of the two paths: something like the dark line in Figure VII.

A more fundamental question which one might address to the problem of craft learning is why, given the immense number of tasks which are involved, it is not more economical to use a formal learning process. The answer, I think, lies less in the nature of formal learning than in the fact that variety (or

Figure VII



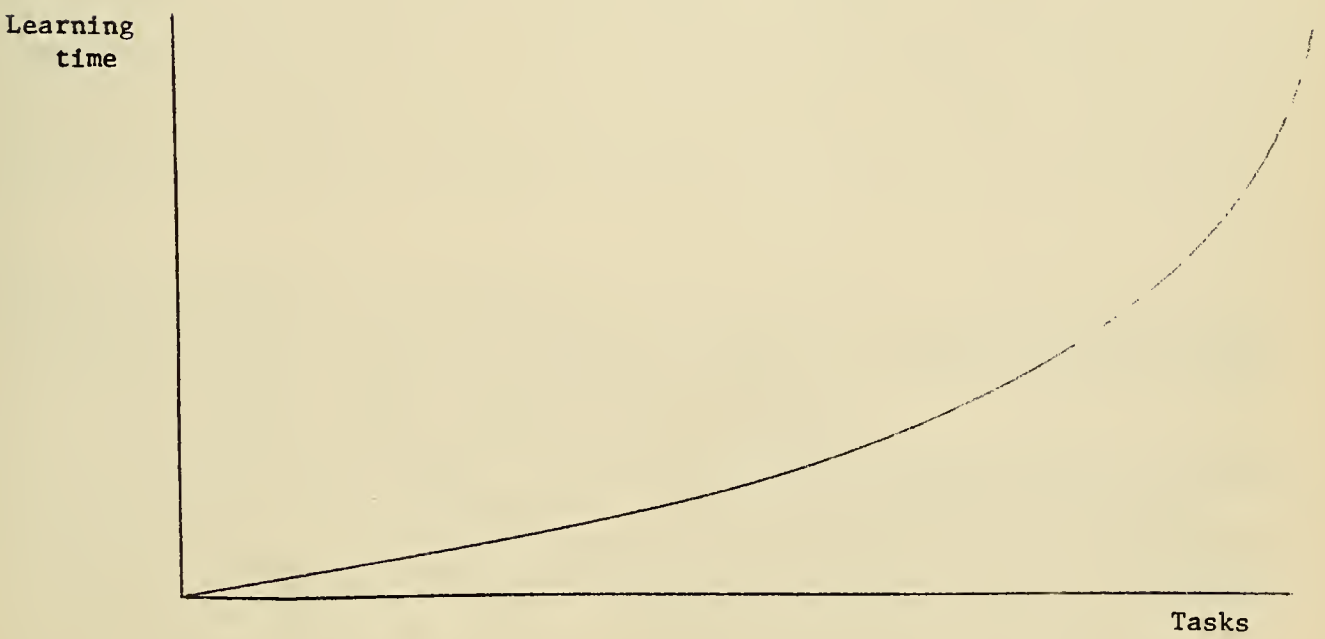


Figure VIII

movement) from task to task is, for one reason or another, built into the structure of craft production, and as a result, automatic-incidental learning curve pictured in Figure VI is, in a sense, stretched out much further along the x-axis. In machine repair, for example, variety in the job is built into the randomness of the process through which various parts of the machine break down in a way which is not present in the putting together of the machine when it is initially manufactured. In construction, the weather, the short duration of jobs, and the uniqueness of individual building sites seem to have a similar effect. It might also be noted that, perhaps because of the random element in the way tasks present themselves on craft jobs, learning tends to be less automatic and incidental than elsewhere. Jobs must be specially divided in order for a helper to learn from a craftsman, and this implies a specific learning curve more like that of Figure VIII than of Figure VI (or VII).[13]

C. The Division of Labor and the Skill Requirements of Jobs

To link Adam Smith's postulates about division of labor to the concepts of job skills and worker traits just developed requires a theory of the relationship between the division of labor and the distribution of jobs by skill level (or what amounts, given our definition of skill, to the same thing, the distribution of jobs by the number of tasks which they entail). What we want

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[13] The major purpose of this formulation of the problem is to enable us to translate Adam Smith's idea about division of labor into a demand for various types of workers. Before turning to that task, however, it may be useful to draw out a few of the implications of what we have just said:

1. One of these is that task-general traits will tend to be utilized on jobs which involve a greater number of traits (in our firms are more highly skilled); involve tasks which are innovative; or involve a considerable amount of uncertainty in the tasks which will actually be required and, hence, necessitate a considerable "reserve" capacity on the part of the labor force. The reader will undoubtedly recognize that in any organization jobs vary with respect to these attributes, but that on the whole, the higher level jobs involve more of these attributes than the lower level. It is also true that there is substantial variation among different organizations across the economy with respect to the degree to which these activities are characterized by these attributes. A research and development firm is very different in this respect from a manufacturing firm

to know in other words, is how this distribution shifts as the process of division of labor proceeds.

The distribution at the two end points of the process is dictated by the definition of what that process is. At the very beginning of the process, there is no division of labor, each job is composed of all the tasks required to perform the work involved, and the distribution is bunched at the high skilled end of the scale, as shown in Figure IX. At the end of the process -- again, by definition of what that process is -- the work has been completely decomposed so that each job consists of a single task, and the distribution is bunched at the low skilled end of the spectrum (i.e., Figure X). Thus the beginning and end of the process are dictated, as it were, by the basic logic of the problem. Unfortunately, the logic does not say very much about the intermediate steps through which one proceeds from one end to the other. One can imagine a number of alternatives. For example, it is possible that the process proceeds by dividing the original set of jobs (groups of tasks) in half, and then in half again so that the distribution remains tightly bunched together as it moves to the left. Such a case is shown in Figure XI. Another alternative equally consistent with the logic of the problem, is that the initial set of jobs gets shattered producing clusters of tasks (i.e., jobs) of all different sizes but falling into some standard statistical distribution whose mode then shifts to the left over time as shown in Figure XII. Which of these processes actually prevails is an empirical question.

The hypothesis which I would like to assert -- based upon a variety of scattered pieces of evidence which I will not attempt to muster here -- is that the process does indeed more closely resemble that pictured in Figure X than in Figure IX but with some modifications. The most important of these modifications

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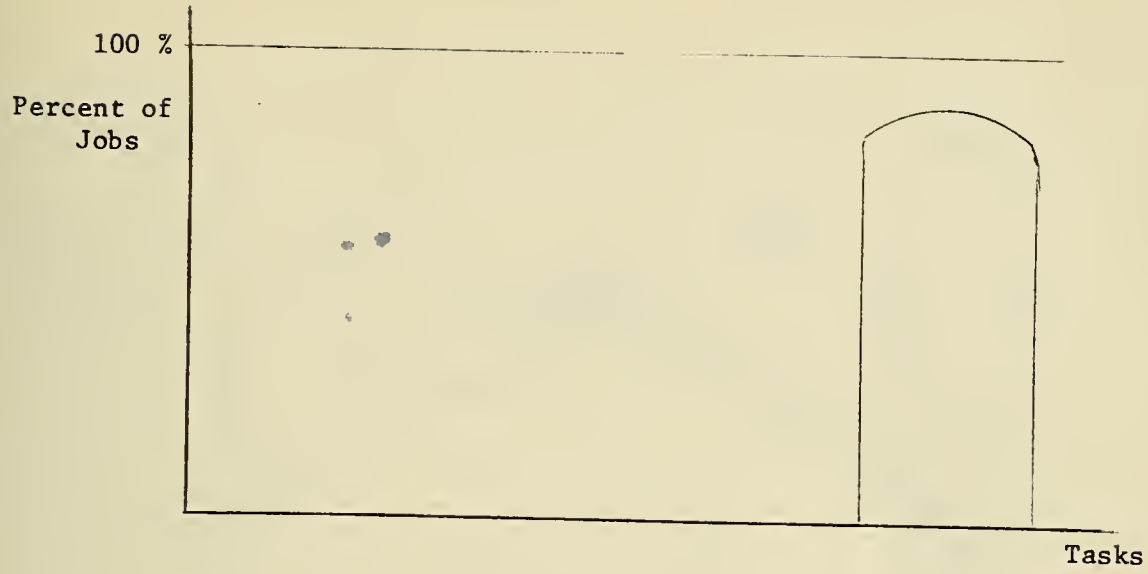
with an established line of standarized products.

2. A second implication is that the distinction appears to hold a clue as to the structure of compensation.

Figure IX



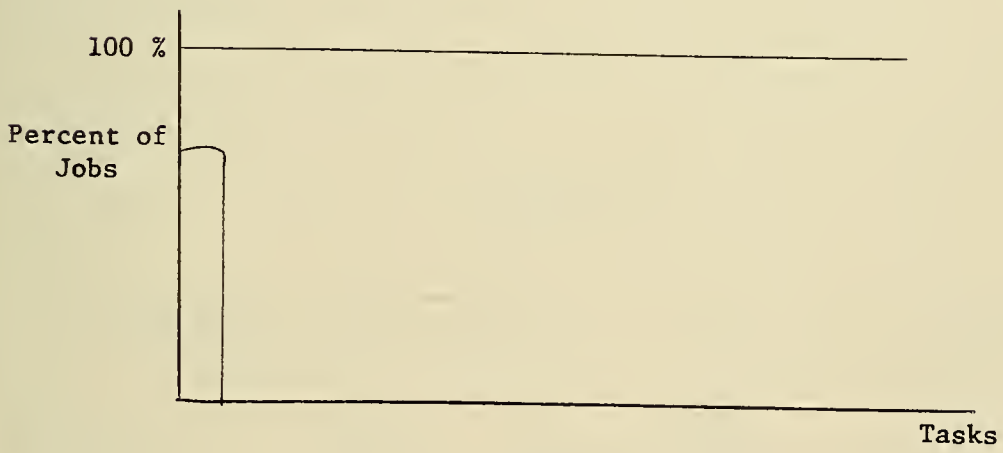


Figure X

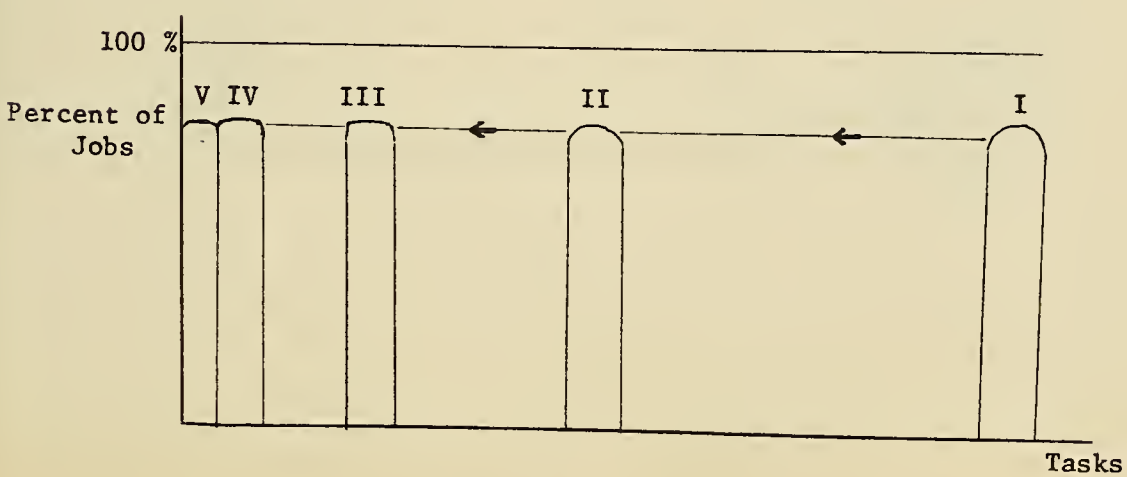


Figure XI

Figure XII

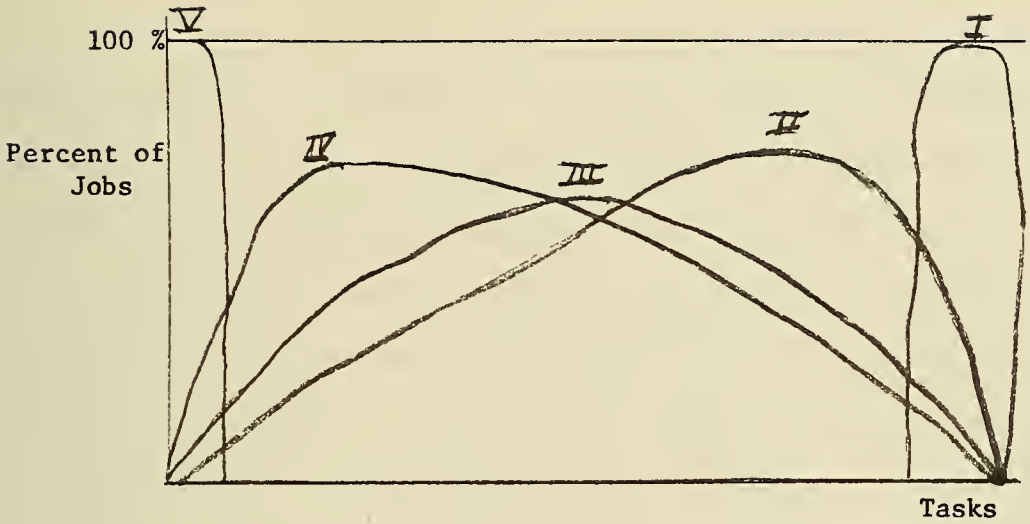
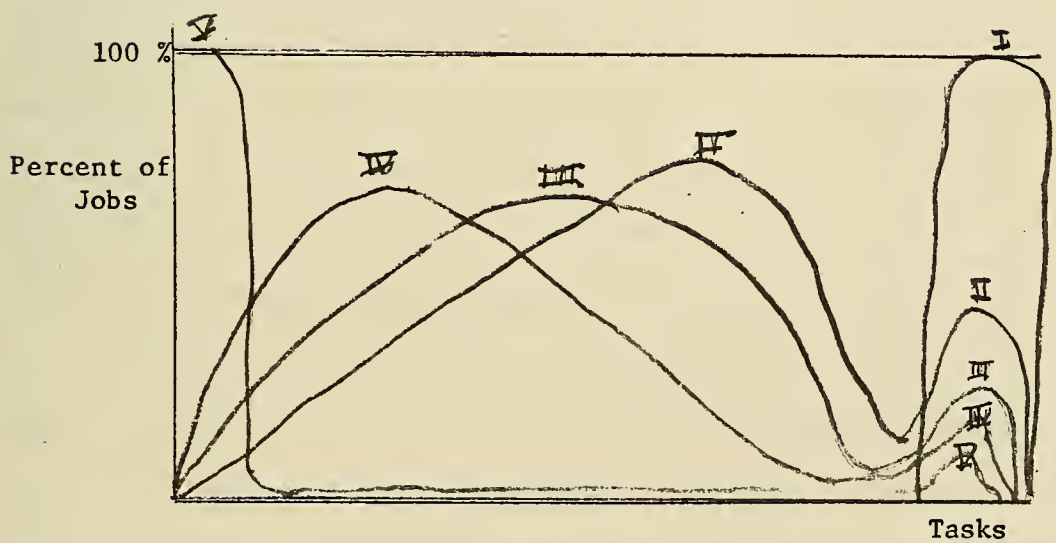


Figure XIII



is that the very first step in the division of labor is to separate from the highly skilled jobs of which the technology consists, the simplest tasks -- the kind which virtually anybody can do without either training or acclimatization -- so that the distribution of jobs first becomes bimodal. In picturing this bimodality, the idea that skill can be equated with numbers of tasks is perhaps too confining; because the tasks are unskilled, numbers of them can be combined in a single job without affecting what we conventionally think of as the skill level. The bimodality of the distribution by skills may not therefore appear in terms of tasks. At any rate, it is only after this basic separation of unskilled tasks has occurred, that the division of labor which creates positions of intermediate skill begins to take place.

The second modification in this pattern relates to the end point of the process. This end point appears to involve something less than a complete concentration of jobs at the low point of the skill spectrum. Instead, it seems to leave a series of very highly skilled jobs at the other end, so that the final outcome is bimodal in a way very similar to that which emerges at the very beginning of the process. If this is true, then the upper mode must begin to appear at some point early in the process, yielding an evolution like that in Figure XIII. The major piece of evidence for the existence of this vestigal high skilled mode comes from experiments in job redesign to combat worker alienation.

There are several ways of understanding the development of this second mode in the job structure. All of these explanations can be phrased in terms of the earlier discussion as amounting to a kind of parallel within the enterprise to what generates a dual product market in an industry. What permits the separation of work into separate tasks, each of which comes to constitute a distinct job, is that the tasks are repeated so frequently that the person assigned them is kept fully employed. No productive enterprise runs so smoothly,

however, that all the operations are routine, and hence, as the routine tasks are separated out, there remain a vestige of nonroutine situations involved with breakdowns or failures of the normal processes; the job of handling these situations is multi-tasked and hence, highly skilled.

It seems to me that one could attribute this vestigal mode simply to the fact that the "perfect" world in which certainty and stability have been fully realized is impossible and, hence, the theoretical end point to the division of labor is never reached. However, several of the interpretations of the experiments with job enrichment imply that the division of labor actually increases the number of unpredictable situations which must be handled elsewhere in the system. Among the reasons why this might be so are the problems of coordinating the divided labor and those of motivating a bored or "alienated" labor force.

There is still another interpretation of this vestigal mode, which points in a completely different direction, but which for completeness should be mentioned. It could be that the jobs in that mode, which have to do with direction and coordination, are not in fact any less routine or more complex than other jobs in the enterprise, but they are different in that they require authority over others. That authority could require that the incumbent gets paid more than his subordinates and that what is perceived as a technical difference in skill level is actually a difference in income that has a social function unconnected to skill level in the sense that we have been using that term.

In conclusion then, the impact of the process of progressive division of labor upon the skill distribution of jobs can be summarized as a four stage process: a first stage, in which tasks are undivided and all jobs are, in this sense, highly skilled; a second stage in which the essentially trivial tasks

are split off and assigned to separate jobs so that the job distribution becomes bimodal; a third stage, in which the multi-task skilled work is progressively divided into separate tasks, the distribution spreads out over a range of tasks, and the mode shifts progressively to the right; and a final stage in which most routine work has been divided into single task jobs which constitute one mode of the distribution and a second vestigal mode of the distribution and a second vestigal mode of highly skilled coordinating jobs emerges on the right.

V. The Relationship Between Labor Market and Product Market Structure

The implications of the preceding analysis for the structure of labor markets may be briefly summarized in terms of the earlier stages. Jobs in the first stage lend themselves to incorporation in the upper tier of the primary market; in the second stage, to the upper tier and to the secondary sector: in the third stage to the two tiers of the primary sector, and in the last stage, like the second, to the upper tier and the secondary sector. In the modern economy, then, the lower tier of the primary sector will tend to be associated with the core of large, mature industries. The periphery of these industries, new industries, declining industries, and those which have, for one reason or another, naturally small markets will tend, relative to the core, to generate both more upper tier jobs and more secondary jobs. In underdeveloped economies the modern sector will tend to generate upper and lower tier primary jobs, the traditional sector upper tier (and craft) jobs on the one hand and secondary jobs on the other.

Two points here should be emphasized: First, the linkage between secondary jobs, generally considered the least favored positions in the society, and upper tier jobs, which are the most favored positions. This is perhaps the greatest departure suggested by the theory from current thinking about labor stratifications. Perhaps the most dramatic example of the linkage is the

modern hospital, but many small manufacturing job shops exhibit a similar dichotomy with a few very skilled workers who lay out the jobs and several virtually unskilled workers who perform them.

The second point to be emphasized is that the labor market sectors do not necessarily coincide with the product market sectors. This point is apparent in the case of upper tier jobs, which are found in all of the stages of the division of labor and, hence, in each of the different types of firms associated with these stages. It is less clear in this presentation for the secondary sector but a more complete typology of the product market than we have developed here would probably want to distinguish among different kinds of peripheral firms (those who absorbed the fluctuations of industries with a stable sector, for example, those who themselves faced a stable demand but a small market, and those who were in new, expanding industries) all of which, however, would generate secondary jobs. In the present context, those jobs are linked together by the fact that they lie at the same point in one underlying technological process. In the United States economy, they also seem to be linked together by the fact that they share the same labor force: unskilled labor does move back and forth between restaurants, hospitals, small scale job shops, and petty manufacturing firms who subcontract from the stable sector of the industry. Similarly, although is seems to take a different temperament, the training of professionals and managers who go into peripheral firms is the same as for those in the core, and if movement between these two sectors is limited, the labor force is drawn from the same educational institutions and there is at least some mid-career shifting. The differences among types of firms, however, do appear to provide natural points for further distinctions in the labor market to develop (or to be imposed) and one could not necessarily expect to find the kinds of labor force mobility apparent in the United States in other economies. In particular, in underdeveloped countries, one would not be

surprised to find barriers to movement between essentially upper tier jobs in the modern sector and the traditional sectors.

It is perhaps appropriate, in fact, to end by reemphasizing this point, made initially in the introduction: The theory developed here is designed to explain the technological foundations of dualism but is not supposed to be a theory of technological determinism. Other forces intervene to determine the actual labor market structure. The point can be made by a very specific example.

The border line between the primary and the secondary sectors, particularly in very mature industries who, in terms of the stages which we have been using to discuss the division of labor, have reached the end of the third stage and are entering the fourth, is likely to be greatly influenced by institutional consideration. The effect of institutions is the freeze, a set of rules for the allocation and pricing of labor. Since the essentially unskilled nature of the jobs in the fourth stage is reached gradually over time through the evolution of a job structure that initially lends itself to the lower tier of the primary sector. The institutions are likely to affect the needs of that job structure and inhibit the adjustment to a secondary market even after the technology makes such an adjustment feasible and, possibly even a great deal more efficient. The explanations in New England of the movement of traditional textile, garment and shoe industries can be understood as an attempt to escape such institutional restrictions by moving to underdeveloped regions in the U.S. and abroad where the labor force was much more willing to accept secondary jobs.[14]

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[14] The effect, incidently, is to leave behind in that part of the industries which remain in New England a bimodal job structure, since those jobs which require high skills cannot apparently be exported and the technology with which those jobs are associated is in our stage II, and carries a second, unskilled mode. The jobs in that mode then become secondary jobs; they are nominally governed by the work rules of the primary sector but workers who normally work in that sector will not take them because the industry has developed a reputation as declining and because the bimodal job structure offers little opportunity to learn the skilled jobs. And the secondary workers who do take them cannot for a variety of reasons support the primary institutional structure.

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